Arthur M. Winer, Ph.D.
383 Lindsay Way
Eastsound, WA 98245
(360-376-5045) amwiner@ucla.edu

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TO: U.S. Army Corps of Engineers
Washington Department of Ecology
Whatcom County, Washington

From: Arthur M. Winer, Ph.D.
Orcas Island Resident and Distinguished Professor Emeritus, Environmental Health Science Department, UCLA School of Public Health

RE: Significant, Adverse, and Forseeable Air Quality Impacts from the Gateway Pacific Terminal Proposed for Cherry Point, Including Localized Human Exposure, Health Effects and Environmental Justice Inequalities

My Qualifications to Comment

I have owned property on Orcas Island, WA since 1979 and have been a resident of Orcas Island since 2010 following my retirement from the UCLA School of Public Health (SPH) where I was a Distinguished Professor of Environmental Health Sciences, with a research specialty in human exposure to air pollutants, and Director of the UCLA Environmental Science and Engineering Program for nine years. I currently hold Emeritus appointments in the UCLA SPH and the UCLA Institute of the Environment and Sustainability, and I continue to conduct research, publishing four peer-reviewed journal articles in 2012.

In the course of a forty-year career, I have published two hundred peer-reviewed journal articles and sixteen book chapters on key air pollution topics. In the last 15 years, my research has focused primarily on air pollutant exposure measurements, including localized exposures related to diesel- and gasoline-mobile source emissions; community-based monitoring; and children's exposures in diesel school buses, schools and homes.

In addition to my research and teaching contributions, I have worked for three decades at the local, state, national, and international levels to promote legislation and public policies designed to address a broad range of air pollution, environmental justice, public health and urban planning concerns. Specifically, I have served as an advisor to the President's Council on Environmental Quality, EPA's Clean Air Scientific Advisory Committee, the National Academy of Sciences/National Research Council, the Health Effects Institute, California's Air Resources Board and the South Coast Air Quality Management District.

I am a member of the International Society of Exposure Analysis, the American Chemical Society, the Air and Waste Management Association, and the American Association for the Advancement of Science, and I have received numerous awards for my contributions to the air pollution field, including the Haagen-Smit Award, the Carl Moyer Award for Scientific Leadership, the American Lung Association of California's Clean Air Award, as well as commendations from Congress.

Local and Regional Air Quality Impacts: Human Exposure, Health Effects and Environmental Justice

Background

Over the past decade the focus of regulators and air pollution researchers has largely shifted from regional air pollution problems to more localized, direct exposures of populations to emissions from mobile sources such as motor vehicles and diesel locomotives. This change in focus is the result of several factors. First, in most U.S. airsheds the National Ambient Air Quality Standards (NAAQS) for the six criteria pollutants are either already met (e.g. lead, nitrogen dioxide, sulfur dioxide, carbon monoxide) or are close to being met (ozone, PM2.5).

Second, air pollutant exposure assessments now focus specifically on determining what people are breathing where they spend their time, rather than using air quality measurements at a few widely spaced outdoor air monitoring stations to infer exposure of people many kilometers away. Third, concern has grown that focusing only on the criteria pollutants regulated under the NAAQS fails to address the potential health effects of other critical, but presently unregulated, combustion-related species such as ultrafine particles (UFP) which can cross the blood-brain barrier and penetrate cell walls.

Finally, a large body of peer-reviewed literature indicates that exposure to mobile sources emissions, e.g. diesel exhaust particulate (DEP), causes a wide range of morbidity—asthma, respiratory illness, reduced lung function, and low birth weight and premature birth in newborns—as well as increased mortality, especially in vulnerable populations such as infants, children, the elderly and pregnant women (Brunekreef et al., 1997; van Vliet et. al., 1997; Venn et al., 2001; Lin et al., 2002; Hoek et al., 2002; Janssen et al., 2003; Wilhelm and Ritz, 2003; McConnel et al., 2006; Beelen et al., 2008; Gehring et al., 2010; Hoek et al., 2010; Wellenius et al., 2012;).

Specifically regarding diesel emissions from locomotives, the California Air Resources Board conducted a risk assessment study in 2000 for the large railyard at Roseville, CA, which has the unique feature of an absence of truck traffic thereby allowing assessment of health impacts only from the diesel locomotives. In this study, Hand et al. (2004) identified cancer risk levels of 500 per million in the neighborhood immediately downwind of the railyard, and 100 per million well downwind in the Roseville community. These results were later confirmed by Cahill et al. (2011) in an independent study (see below). Both of these studies showed that a major fraction of the emissions came from idling diesel locomotives.

A. Rail Transport of Coal for the GPT Project

1. Exposure of Downwind Human Populations to Regulated and Un-Regulated Air Pollutants

   Over the past decade a major research effort has been conducted to characterize the air pollution exposures of human populations adjacent to, and downwind of, important transportation-related emission sources, including roadways, airports,

shipyards, and rail lines and rail yards. In addition to using fixed-site monitoring, much of this research has been conducted using mobile monitoring platforms (MMP) consisting of electric vehicles with no pollution of their own, on which are installed state-of-the art instruments for measuring both regulated and un-regulated air pollutants (Westerdahl et al., 2005; Hu et al., 2009a; Kozawa et al., 2009; Choi et al., 2012a; Quiros et al., 2013). These studies have shown that the impacts of emissions from these mobile sources extend up to 2-3 kilometers downwind, especially during nocturnal surface temperature inversions (Kerminen et al., 2007; Hu et al., 2009b; Choi et al., 2012a).

The frequency of diesel locomotives passing through highly populated areas under the proposed GPT project would make these rail lines essentially "line sources" for locomotive diesel exhaust, thereby producing chronic downwind air pollution impacts in adjacent populations, similar to those observed for roadways with diesel (and gasoline) vehicle traffic. These line-source emissions from the diesel locomotives themselves would be exacerbated by the air pollution from large the numbers of cars and trucks idling for long periods of time while long and slow coal trains cross roads with no over- or under-passes.

2. Data from Fixed-Site Monitoring Networks are Inadequate to Assess Exposures

It is important to stress that a scoping study that relies only on data from, or models related to, the standard fixed site monitoring network of local or regional air quality agencies in western Washington will completely fail to capture the true air pollutant exposures created by rail traffic associated with the proposed GPT project. As discussed above, it is now well recognized that a few widely scattered air monitoring stations are of little value in characterizing the highly localized exposures of populations to the air pollutants they are actually breathing in proximity to mobile source emissions.

Today it is recognized the principal value of traditional air monitoring networks is to track over long periods of time compliance of air agencies with the NAAQS for the few air pollutants regulated under the NAAQS. Indeed both Federal agencies, such as the U.S. EPA and the National Highway Transportation Agency, as well as state air agencies such as California's Air Resources Board, now require localized air monitoring adjacent to, and downwind of, transportation-related "line sources" in order to more accurately characterize the exposures and health impacts of air pollution from these major sources.

Need for Comprehensive Study: It is therefore important to measure and/or model the downwind concentrations of air pollutants, and resulting human population exposures, within 3 kilometers of the rail lines which would be used by diesel locomotives for the proposed GPT project along the entire length of those rail lines.

3. Focus on Un-Regulated Pollutants as well as Regulated Air Pollutants

The serious health effects of the air pollutants regulated under the NAAQS have been recognized for decades. This scoping study must, of course, account for exposures to diesel locomotive exhaust pollutants such as nitrogen dioxide and sulfur dioxide. And, as discussed above, assessments of exposures to NAAQS pollutants must be based on air quality measurements or modeling for populations adjacent to, and downwind from, the rail lines used for the proposed project, not just on data from distant air monitoring stations.

However, there are several key air pollutants and classes of air pollutants (e.g. heavy metals) which are presently not regulated under the NAAQS framework, but that pose potentially serious health impacts, not just morbidity but also mortality, for populations downwind of the rail lines which would be used for the proposed GPT project. Four of the most important such pollutants are diesel exhaust particulate (DEP), ultrafine particles, heavy metals and polycyclic aromatic hydrocarbons (PAH).

a. Diesel Exhaust Particulate

Based on an overwhelming body of evidence, DEP has been declared a toxic air contaminant by the U.S. EPA and the California ARB. Peer-reviewed literature from all over the world has documented both increased mortality and a wide range of morbidity effects for children and adults living adjacent to roadways with heavy diesel truck traffic (see references above). It is important to recognize that the frequency of locomotive trips for the GPT project (both loaded and empty trains) will create a diesel pollution "line source" analogous to a roadway with heavy-duty diesel truck traffic.

Need for Comprehensive Study: It is therefore important to assess the potential health impacts that could result from chronic and cumulative exposures to diesel exhaust particulates over periods as long as decades for populations living, schooling or working within the downwind plumes of GPT-related diesel locomotives.

b. Ultra-fine Particles from Diesel Locomotives

Particles less than 100 nanometers in diameter, commonly called nanoparticles or ultrafine particles (UFP), are emitted from all fossil fuel combustion sources, including diesel locomotives. Because these tiny particles are able to penetrate cell walls and cross the blood-brain barrier there is currently in the scientific and regulatory communities intense focus on their potential human health impacts. Indeed, UFP appear to have the potential to be a 'causative agent' in fresh combustion emissions responsible for degrading health in a variety of ways (Nel et al., 2006).

For example, recent results of a European expert panel elicitation study on UFP health effects suggested a high likelihood of an association between UFP exposure and cardiovascular or respiratory hospital admissions (Hoek et al., 2010). Researchers in the United States have reached similar conclusions based on animal models or epidemiological studies.

The frequency of passage of diesel locomotives hauling coal to, and returning from, the GPT facility will cause a chronic exposure of downwind human populations to elevated concentrations of ultrafine particles, especially in highly populated urban centers through which the trains will pass relatively slowly.

Need for Comprehensive Study: It is therefore important to assess the potential health impacts that could result from chronic exposures to ultrafine particles over periods as long as decades for populations living or working within the downwind plumes of GPT-related diesel locomotives.

c. Heavy Metals

In a comprehensive study of inorganic and organic aerosols downwind of the major railyard in Roseville, California, Cahill et al. (2011a) detected a number of toxic heavy metals, including nickel, lead, and copper. Disturbingly, they found increasing concentrations of the metals with decreasing particle size, suggesting that concentrations could be even higher in the ultrafine particle size range that corresponds to very high lung capture efficiencies. The presence of the very fine metals from the railyard posed a threat over and above that created by the other pollutants observed downwind of the facility. In a subsequent study, these researchers tied these very fine metallic aerosols to ischemic heart disease (Cahill et al., 2011b).

d. Polycyclic Aromatic Hydrocarbons

An important class of compound found in diesel exhaust is the polycyclic aromatic hydrocarbons (PAH), many of which are human carcinogens or mutagens. These compounds are predominately found in the fine and ultrafine particle size ranges in diesel particulate emissions. Cahill et al. (2011) identified 15 different PAH in samples of diesel particulate obtained downwind of the Roseville Railyard in California. The PAHs from locomotive diesel engines showed a markedly different PAH profile compared with emissions from heavy-duty diesel trucks and other on-road applications. Cahill et al. (2011) found that benzo(a)pyrene, one of the most toxic PAH, was detected at levels more than five times higher than in diesel truck exhaust per unit mass.

Need for Comprehensive Study: It is therefore important to assess the potential health impacts that could result from chronic exposures to heavy metals and PAH over periods as long as decades for populations living or working within the downwind plumes of GPT-related diesel locomotives.

4. Assess Indoor Exposures as well as Outdoor Air Pollution

   The rapid penetration of outdoor gaseous and particulate air pollutants into indoor environments of all kinds, including homes, shops and schools, has been studied for several decades and is now well established. Hence, the air pollutant emissions from diesel locomotives associated with the GPT project are of concern not just in ambient outdoor air, but also in indoor environments. Any scoping study must account for such indoor exposures.

Need for Comprehensive Study: It is therefore important to assess the potential health impacts that could result from chronic and cumulative indoor exposures over periods as long as decades for populations living, schooling or working within the downwind plumes of GPT-related diesel locomotives.

5. Environmental Justice Issues

   It is well recognized that mobile source emissions in urban areas often have disproportionate health impacts on minority and low income populations due to the siting of roadways and railways in low socioeconomic status (SES) and minority neighborhoods (Houston et al., 2004; Jacobson et al., 2005; Houston et al. 2006; Houston, Krudysz and Winer, 2008). Typically residents of such neighborhoods have among the lowest vehicle ownership rates and the lowest use of rail transport while their communities are disproportionately traversed and surrounded by railways and roadways. A previous study of exposure of disadvantaged populations adjacent to freeways traversing Seattle and Portland (Bae, Sandlin and Bassok, 2007) clearly indicates the potential for coal-related rail traffic through minority and high poverty neighborhoods in Seattle and other major urban centers in Washington State to result in disproportionate diesel locomotive exposure, health and noise impacts compared with more affluent areas of the region.

   In a broader context, data collection and assessment, as well as estimates of exposures and health impacts in minority and low income populations should be guided by Presidential Executive Order 12898 of February 11, 1994, entitled Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations (Federal Register 1994).

Need for Comprehensive Study: It is therefore important to assess the potential for extensive environmental justice-related disparities in exposure, health, noise and other impacts resulting from GPT Project rail transport of coal, with resulting diesel locomotive emissions, through minority and low-income neighborhoods in major urban centers of southern and western Washington.

B. On-Site Emissions at the GPT Facility

As emissions from light duty motor vehicles and highly regulated stationary sources such as utilities have been dramatically reduced over past decades throughout North America, ports and their associated transport activities have emerged as major and even dominant air pollutant emission sources in many coastal airsheds. The proposed Gateway Pacific coal export terminal is expected to be no exception to this trend. The presence of a wide range of diesel equipment, including fork lifts, cranes, and trucks, in addition to the arrival, departure and especially idling of diesel locomotives, has the potential to make the GPT facility a diesel emission "hot spot."

Given the wide range of morbidity effects, and in some cases mortality, caused by diesel exhaust particulate, ultrafine particles, and other combustion-related pollutants, the air pollution emitted from the GPT facility has the potential to significantly impact human health of the residents of adjacent and nearby communities. Again, it is not sufficient to rely on modeling the air pollutant levels likely to be encountered at monitoring stations long distances from the GPT facility. The impacts of the facility must be modeled with high spatial and temporal resolution adjacent to, and many kilometers downwind from, the port facility.

<u>Need for Comprehensive Study:</u> It is therefore important to quantitatively determine the extent and combined impacts of both regulated and un-regulated (e.g. UFP and DEP) emissions at, adjacent to, and downwind of the GPT facility <u>from all combustion sources</u> within the facility, with particular attention to the health impacts on adjacent and nearby communities.

C. Ship Emissions at Loading Facilities and Within the Salish Sea

Because of the generally poor quality of fuel used in international bulk carriers, especially the high sulfur content of bunker fuel, and the extensive idling of ships when in port and while waiting offshore, the air pollutant emissions at the GPT facility and within the Salish Sea from coal carriers are expected to be egregious. Such emissions have the potential to significantly degrade air quality and visibility not only locally at the facility itself but throughout the region, especially given the large numbers and frequency of such carriers in connection with this proposed coal exporting facility. Again, to adequately assess these impacts requires modeling with high spatial resolution, and not simply modeling anticipated air quality at a few widely scattered air monitoring stations.

<u>Need for Comprehensive Study:</u> It is therefore important to quantitatively determine with high spatial resolution the extent and impacts of both regulated and un-regulated (e.g. DEP and UFP) emissions at, adjacent to, and downwind of the GPT facility from all combustion sources associated with the facility, with particular attention to the health impacts on adjacent and nearby communities.

Literature Cited

Beelen, R., Hoek, G., van den Brandt, P.A., Goldbohm, R.A., Fischer, P., Schouten, L.J., Jerrett, M., Hughes, E., Armstrong, B., Brunekreef, B., 2008. Long-term effects of traffic-related air pollution on mortality in a Dutch cohort (NLCS-AIR study). Environmental Health Perspectives 116, 196-202.

Bae, C-H., Sandlin, G., Bassok, A., Kim, S., 2007. The exposure of disadvantaged populations in freeway air-pollution sheds: A case study of the Seattle and Portland regions. Environment and Planning B: Planning and Design 34, 154-170.

Brunekreef, B., Janssen, N.A.H., de Hartog, J., Harssema, H., Knape, M., van Vilet, P. 1997. Air pollution from truck traffic and lung function in children living near motorways. Epidemiology 8, 298-303.

Cahill, T.A., Cahill, T.M, Barnes, D.,Spada, N.J., Miller, R., 2011a. Inorganic and organic aerosols downwind of California's Roseville Railyard. Aerosol Science and Technology, 45, 1049-1059.

Cahill, T.A., , Barnes, D.,Spada, N.J., Lawton, J.A., Cahill, T.M. 2011b. Very fine and ultrafine heavy metals and ischemic heart disease in the Calfornia Central Valley. Aerosol Science and Technology, 45, 1124-1134.

CARB, 2004. The California diesel fuel regulations. California Air Resources Board, Sacramento.

Choi, W., He, M., Barbesant, V., Kozawa, K.H., Mara, S., Winer, A.M., Paulson, S.E., 2012a. Prevalence of wide area impacts downwind freeways under pre-sunrise stable atmospheric conditions. Atmospheric Environment 62, 318-327,

Federal Resister, 1994. Vol. 59, No. 32, Wednesday, February 16, 1994

Gehring, U., Wijga, A.H., Brauer, M., Fischer, P., de Jongste, J.C., Kerkhof, M., Oldenwening, M., Smit, H.A., Brunekreef, B., 2010. Traffic-related air pollution and the development of asthma and allergies during the first 8 years of life. American Journal of Respiratory and Critical Care Medicine 181, 596-603.

Hand, R. Di, P. Servin, A., Hunsaker, L., Suer, C., 2004. Roseville Railyard Study, Califrornia Air Resources Board, Sacramento, CA.

Hoek, G., Boogaard, H., Knol, A., De Hartog, J., Slottje, P., Ayres, J.G., Borm, P., Brunekreef, B., Donaldson, K., Forastiere, F., Holgate, S., Kreyling, W.G., Nemery, B., Pekkanen, J., Stone, V., Wichmann, H.E., Van der Sluijs, J., 2010. Concentration response functions for ultrafine particles and all-cause mortality and hospital admissions: Results of a European expert panel elicitation. Environmental Science & Technology 44, 476-482.

Hoek, G., Brunekreef, B., Goldbohm, S., Fischer, P., van den Brandt, P.A., 2002. Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study. Lancet 360, 1203-1209.

Houston, D., Wu, J., Ong, P., Winer, A.M., 2004. Structural disparities of urban traffic in Southern California: Implications for vehicle-related air pollution exposure in minority and high-poverty neighborhoods. Journal of Urban Affairs 26, 565-592.

Houston, D., Ong, P., Wu, J., Winer, A.M., 2006. Proximity of licensed child care facilities to near-roadway vehicle pollution. Am. J. Public Health 96, 1611-1617.

Houston, D., Krudysz, M. Winer, A. M., 2008. Diesel truck traffic in low-income and minority communities adjacent to ports. J. Transportation Research 2067, 38-48.

Hu, S., Fruin, S., Kozawa, K., Mara, S., Winer, A.M., Paulson, S.E., 2009a. Aircraft emission impacts in a neighborhood adjacent to a general aviation airport in Southern California. Environmental Science & Technology 43, 8039-8045.

Hu, S., Paulson, S.E., Fruin, S., Kozawa, K., Mara, S., Winer, A.M., 2012. Observation of elevated air pollutant concentrations in a residential neighborhood of Los Angeles California using a mobile platform. Atmospheric Environment, Atmospheric Environment, 51: 311-319.

Hu, S.S., Fruin, S., Kozawa, K., Mara, S., Paulson, S.E., Winer, A.M., 2009b. A wide area of air pollutant impact downwind of a freeway during pre-sunrise hours. Atmospheric Environment 43, 2541-2549.

Jacobson, J.O., Hengartner, N.W., Louis, T.A., 2005. Inequity measures for evaluations of environmental justice: A case study of close proximity to highways in New York City. Environment and Planning A 37, 21-43.

Janssen, N.A.H., Brunekreef, B., van Vilet, P., Aarts, F., Meliefste, K., Harssema, H., Fischer, P. 2003. The relationship between air pollution from heavy traffic and allergic sensitization, bronchial hyper-responsiveness, and respiratory symptoms in Dutch school children. Environmental Health Perspectives 111, 1512-1518.

Karner, A.A., Eisinger, D.S., Niemeier, D.A., 2010. Near-roadway air quality: Synthesizing the findings from real-world data. Environmental Science & Technology 44, 5334-5344.

Kozawa, K.H., Fruin, S.A., Winer, A.M., 2009. Near-road air pollution impacts of goods movement in communities adjacent to the Ports of Los Angeles and Long Beach. Atmospheric Environment 43, 2960-2970.

McConnell, R., Berhane, K., Yao, L., Jerrett, M., Lurmann, F., Gilliland, F., Kunzli, N., Gauderman, J., Avol, E., Thomas, D., Peters, J. 2006. Traffic susceptibility, and childhood asthma. Environmental Health Perspectives 114, 766-772.

Nel, A., Xia, T., Madler, L., Li, N., 2006. Toxic potential of materials at the nanolevel. Science 311, 622-627.

Quiros, D.C., Zhang, Q., Choi, W., He, M., Paulson, S.E., Winer, A.M., Wang, R., Zhu, Y.F., 2013. Near-roadways air quality impacts of a scheduled 36-hour closure of a major highway. Atmospheric Environment 67, 404-414.

Sabaliauskas, K., Jeong, C.H., Yao, M., Jun, Y.-S., Jadidian, P., Evans, G.J., 2012. Five-year roadside measurements of ultrafine particles in a major Canadian city. Atmospheric Environment 49, 245-256.

van Vliet, P., Knape, M., de Hartog, J., Janssen, N., Harssema, H., Brunekreef, B. 1997. Motor vehicle exhaust and chronic respiratory symptoms in children living near freeways. Environmental Research 74, 122-132.

Venn, A.J., Lewis, S.A., Cooper, M., Hubbard, R., and Britton, J. 2001. Living near a main road and the risk of wheezing illness in children. American Journal of Respiratory Care Medicine 164, 2177-2180

Wang, Y.G., Hopke, P.K., Chalupa, D.C., Utell, M.J., 2011. Long-term study of urban ultrafine particles and other pollutants. Atmospheric Environment 45, 7672-7680.

Wellenius, G.A., Burger, M.R., Coull, B.A., Schwartz, J., Suh, H.H., Koutrakis, P., Schlaug, G., Gold, D.R., Mittleman, M.A., 2012. Ambient air pollution and the risk of acute ischemic stroke. Arch. Intern. Med. 172, 229-234.

Westerdahl, D., Fruin, S., Sax, T., Fine, P.M., Sioutas, C., 2005. Mobile platform measurements of ultrafine particles and associated pollutant concentrations on freeways and residential streets in Los Angeles. Atmospheric Environment 39, 3597-3610.

Wilhelm, M., Ritz, B., 2003. Residential proximity to traffic and adverse birth outcomes in Los Angeles County, California, 1994-1996. Environmental Health Perspectives 111, 207-216.

Zhu, Y.F., Hinds, W.C., Kim, S., Sioutas, C., 2002. Concentration and size distribution of ultrafine particles near a major highway. Journal of the Air & Waste Management Association 52, 1032-1042.

Zhu, Y.F., Kuhn, T., Mayo, P., Hinds, W.C., 2006. Comparison of daytime and nighttime concentration profiles and size distributions of ultrafine particles near a major highway. Environmental Science & Technology 40(8), 2531-2536.